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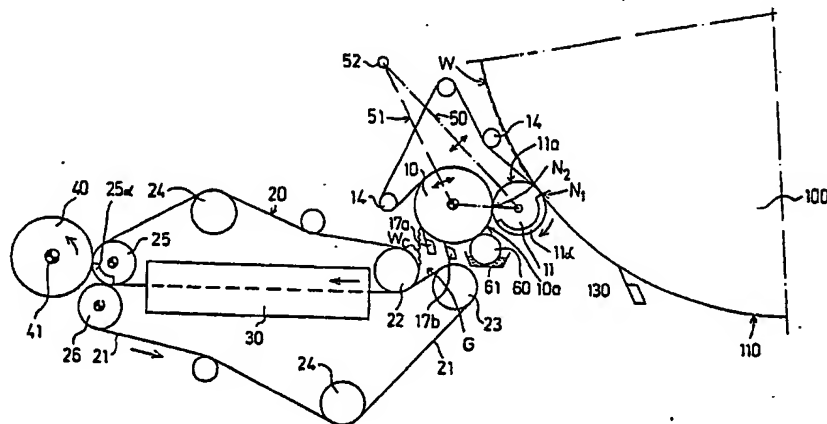
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(54) Title: PROCEDURE AND PAPER MACHINE FOR MANUFACTURING CREPED PAPER WEB



(57) Abstract

Procedure for manufacturing a tissue web (W), which is dewatered in a press section (80), whereafter the web (W) is conducted to a drying section (94; 100; 100'), where the web (W) is dewatered by evaporation. The web (W) is conveyed in closed conduction from the surface of the last drying cylinder (94; 100; 100') in the drying section onto the suction zone (11α) of a transfer suction roll (11). The web (W) is further transported in closed conduction to a smooth-surfaced creping roll (10) or creping cylinder by means of a creping doctor (17a, 17b) and the web (W) is transferred to the subsequent treatment steps. The tissue paper machine comprises a Yankee cylinder or a flow-through cylinder and a reeling means (41). The paper machine further comprises a transfer suction roll (11) with a suction zone (11α) defining a transfer nip (N1) together with the drying cylinder (100, 100'). A smooth-surfaced creping roll (10) or creping cylinder defines a transfer nip (N2) together with said transfer suction roll (11). A creping doctor (17), which detaches the tissue web (W) from the surface of said creping roll (10) or creping cylinder.

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**PROCEDURE AND PAPER MACHINE FOR MANUFACTURING CREPED
PAPER WEB**

The present invention concerns a procedure for manufacturing a creped paper web, wherein the web is formed in the forming section of a paper machine and the web is dewatered in the press section, where-
upon the web is conducted to the drying section, where the web is de-
5 watered by evaporating.

The invention further concerns a paper machine comprising at least one drying cylinder, such as a Yankee cylinder or a flow-through cylinder, and a reeling means.

10

The manufacturing of a creped paper web or tissue takes place traditionally on a so-called Yankee machine, and it comprises the following steps:-

- 15 - dewatering of the fiber suspension and web forming on the wire section of the paper machine, which may be of the single-wire or twin-wire type;
- dewatering of the web by pressing, which may be accomplished in a nip between two press rolls before the Yankee cylinder or in a nip
20 defined by a press roll against the Yankee cylinder;
- web drying on the Yankee cylinder, in addition to or instead of which sometimes a so-called flow-through drier may be used;
- web creping by the aid of a doctor operating against the surface of the Yankee cylinder;
- 25 - after-drying of the creped web in case the creping has been done with the web still moist or wet; and
- reeling of the web.

The present invention concerns equipment associated with the manu-
30 facturing of creped paper or tissue in general and, in particular, with web creping which does not take place on the Yankee cylinder and its after-drying.



In the most commonly applied procedures serving the manufacturing of creped paper web, the wet paper web which is to be dried and treated is conducted onto the Yankee cylinder, which brings about the drying event, and where it is pressed thereagainst. It is well known that in attempts to increase the machine speeds the drying capacity of the Yankee cylinder has constituted a limitation for the production capacity of the paper machine. In order that the drying capacity of the Yankee cylinder might be fully utilized in a paper machine producing creped grades, it is usual to remove water as much as possible from the wet paper web before commencement of the evaporation drying proper, by heavy pressing. This is accomplished with the aid of one or two Yankee cylinder presses. However, the softness and adsorption characteristics of the final product are significantly impaired in this case.

As is known in the art the press section of the tissue paper machine may consist either of a conventional wet press with a press nip defined between two press rolls before the Yankee cylinder and/or of one or two press rolls which define press nips against the Yankee cylinder. The drying section, again, is constituted either by the said Yankee cylinder and/or of flow-through drier alone or with a so-called after-drier. In both instances the drying of the web takes place by evaporation effect as the moist web is in contact with the Yankee cylinder and the cylinders of the after-drier, if any, all of which are heated by internal pressurized steam. The web which has become adherent the smooth surface of the Yankee cylinder is detached therefrom with the aid of a special doctor blade, which causes in the web a creping created by an upsetting effect.

The after-drier most commonly consists of a plurality of conventional steam-heated drying cylinders. Particularly, in the case of thin paper grades or tissue the after-drying may be totally omitted.

In tissue paper machines of prior art, thin paper grades are usually dry-creped as a rule with web moisture content about 5 to 10%, whereas for thicker grades (basis weight over 25 g per m²) most often a wet creping procedure is used, in which the moisture content of the



web is about 30 to 40%. In the latter case a separate after-drier is needed to remove the residual moisture prior to reeling.

Creping is carried out by scraping the web off from the surface of the Yankee cylinder by means of a doctor blade. The creping takes place in that the web is made to impinge against the side of the doctor blade, thereby causing in the web a deformation due to up-setting, and formation of waves and wave packages transversal to the direction in which the web runs, and inter-fibre tensions which at least partially remain permanent during the after-drying of the web.

The creping doctor blade is a component subject to wear and therefore it requires to be replaced at comparatively short intervals for a constant quality of creping. Such replacements are made about five to ten times daily. This causes breaks in the production of the paper machine. In view of this it is suggested in the Applicant's Finnish patent application No. 763657, to make the blade of the creping doctor of one or several parts so that the blade has a length considerably in excess of the breadth of the Yankee cylinder and to make provisions for displacement of the blade in its longitudinal direction in the guide constituted by the doctor beam.

It is also known that creping may be done on a separate creping cylinder after the drying. But this is a method in which the desired properties of the creped product are achieved by admixing to the stock elastomer materials before the drying and creping processes, and in which the web-transporting fabric operates at the same time as pick-up fabric by the aid of which the web is detached from the forming wire. It is very difficult in practice to find any such fabric which would serve both as pick-up fabric, as flow-through fabric and as transfer fabric so that all these tasks would be managed, if not more than satisfactorily even.

Regarding the state of art relevant to the present invention, reference is further made to the same applicant's Finnish patent application No. 790924, disclosing a tissue paper machine with the characteristic feature that a particular fabric is conducted against

the tissue web lodged on the surface of a drying cylinder, this fabric serving as member conveying the web onward from said drying cylinder and by its aid being achieved, due to the differential velocity between the drying cylinder and said fabric, an upsetting of
5 the web and/or a surface pattern embossed by said fabric.

It is a known fact that the surface of the Yankee cylinder is subject to wear. Above all, this wear and tear is due to the effect of the creping doctor blade. However, the surface quality and smoothness of
10 the Yankee cylinder's surface exerts a decisive influence both on the drying event and, above all, on the creping event. Therefore, in order to keep the Yankee cylinder's surface smooth enough its repeated grinding is necessary. As has already been noted, the creping doctor blades, too, are subject to powerful wear, and they require
15 indeed to be changed at frequent intervals. But such operations cause prolonged shut-downs with attendant, significant production losses.

With a view to increasing the service life of the Yankee cylinder's surface and the length of the grinding interval, it is known in the
20 art to apply surface coatings made by spraying stainless steel, or high-grade steel in general, on the surface of the Yankee cylinder. It has indeed been possible by these expedients of prior art, considerably to lengthen the grinding intervals of the Yankee cylinder surface and also to prolong the service life of the doctor blades.
25 But the use of Yankee cylinder coatings with e.g. about 2.5 to 3 mm thickness made by metal spraying or in another equivalent way is accompanied by the detriment that the Yankee drier's drying capacity is substantially reduced because the thermal conductivity of stainless steel, for instance, is substantially less than that of cast
30 iron for instance. Calculations indicate that said coatings reduce the drying capacity of the Yankee drier up to about 20%.

The specific object of the present invention is to provide a tissue paper machine in which the above-mentioned drawbacks are avoided. It
35 is an additional object of the invention: to provide a paper machine for creped grades wherein the web can be transported all the way up to the reeling means to highest possible extent in no-draw con-



duction, without unsupported web runs which are apt to cause breaks and shut-downs. Above all, this aims towards making it possible to increase the speed of tissue paper machines and their production capacity as far as other preconditions permit.

5

In order to achieve the aims mentioned, and others which will become apparent later on, the procedure of the invention is mainly characterized in that the web is detached in no-draw conduction from the surface of the last drying cylinder of the drying section by means of a transfer suction roll, by which the web is further transported to a smooth-surfaced creping roll or cylinder, and that the web is creped on the smooth surface of said creping roll or cylinder by means of a creping doctor, whereupon the web is transported to the subsequent after-treatment steps.

15

The paper machine for producing creped paper according to the invention, again, is mainly characterized in that the creping unit in this paper machine comprises, in combination:-

- 20 (a) a transfer roll with suction zone which defines a first transfer nip with the drying cylinder and by the aid of which the web is detached without creping doctor from the surface of the drying cylinder;
- 25 (b) a smooth-surfaced creping roll or cylinder, which defines a second transfer nip together with said transfer suction roll; and
- (c) a creping doctor, by the aid of which the paper web is creped and detached from the surface of said creping roll or cylinder.

30

In the following, the invention is described in detail, with reference being made to three embodiment examples of the invention, presented in the figures of the attached drawing.

- 35 Fig. 1 presents in schematic elevational view, a paper machine applying the procedure of the invention.



Fig. 2 presents in schematic elevational view in greater detail the creping means of the invention, disposed in connection with a Yankee cylinder.

- 5 Fig. 3 presents in partial projection an embodiment of the invention in which a flow-through drying cylinder is used.

As shown in Fig. 1, the paper machine comprises a forming and wire section, of which in Fig. 1 only the trailing end 70 of the wire
10 section is visible. From the forming wire 71, the tissue web is transferred by means of a pick-up roll 72 known in itself in the art, onto a felt 73, the web W being carried, made adherent to its underside, to the same applicant's so-called Sym-Press press section 80. The no-draw press section 80 comprises a first double-felted nip and
15 thereafter two press nips associated with the smooth-surfaced central roll of the press. After the last press nip, the web W is conducted to the first drying cylinder 91 of the multiple cylinder drier 90. The multiple cylinder drier 90 is in itself known in the art, and it consists of steam-heated, smooth-surfaced drying cylinders dis-
20 posed in two rows one upon the other, in connection with these cylinders an upper felt 92 and a lower felt 93 being provided. Uno-Run system is also possible.

From the last drying cylinder 94, the web W is detached and conducted
25 in accordance with the procedure of the invention, using a transfer suction roll 11, onto the creping roll 10 or cylinder. This has a smooth surface 10a, from which the web W is detached, and creped, by the first creping doctor 17a. There are two creping doctors one after the other, namely, the doctors 17a and 17b, the latter being
30 placed in operation in case the first doctor 17a has to be serviced, e.g. in connection with blade replacement. The web denoted by W_{out} which is detached from the surface of the creping cylinder 10, and which has been creped, is conveyed to the subsequent treatment steps which are shown in Figs 2 and 3. The invention shall be described
35 in greater detail with reference being made to these figures.

As shown in Fig. 2, the creping means has been disposed in connection



with the Yankee cylinder 100, which is steam-heated in a manner known in itself in the art and has a smooth cylinder surface 110. In order to ensure good thermal conductivity, the surface 110 of the Yankee cylinder 100 is an uncoated, ground and polished cast surface or a welded steel surface. The web W is carried onto the Yankee cylinder in conventional manner from the paper machine's press section, which has not been depicted.

The web W is detached from the surface 110 of the cylinder 100 without using any creping doctor. The detachment and further conveying of the web W in accordance with the invention takes place with the aid of a suction transfer roll 11, which defines a first transfer nip N_1 together with the cylinder 100. The transfer suction roll 11 has been provided with an extensive suction zone 11 α , which ensures that the web W is maintained on the surface of the roll 11 as it moves from the transfer nip N_1 to the second transfer nip N_2 , which is defined between the transfer suction roll 11 and the creping roll or cylinder 10 of the invention. The transfer roll 11 may be steel-jacketed and/or provided with a coating 11a of rubber or equivalent elastic material known in itself in the art, which has for instance the effect that the nip N_1 will be comparatively broad and it will at all events be such that it does not substantially detract from the softness and fluffiness of the tissue web. The transfer suction roll 11 is lapped by a fabric 13, for instance a suitable metal or plastic-fabric, which serves the purpose to prevent the marking of the web W by the drilling or grooving pattern of the suction roll 11. At the same time, the fabric 13 serves as member carrying the web to the nip N_2 against the smooth surface 10a of the creping roll or cylinder 10. It is well known, of course, that it is of decisive importance with a view to the creping process that the web is made adherent to the creping substrate reliably and with an appropriate degree of adherence - in the present instance to the smooth surface 10a of the creping roll 10 or cylinder with comparatively small diameter. The creping roll 10 may be provided with heating means. The creping cylinder 10 may have a structural design equivalent either to a paper machine cylinder or e.g. a press roll.



- The creping roll 10 has a diameter considerably smaller than that of conventional Yankee cylinders 100, but its diameter is appropriately larger than that of the transfer suction roll 11. The smooth surface 10a of the creping cylinder 10 has been made of a material as hard as possible, for instance of chrome steel or equivalent. In some instances non-metallic coatings may also be used. The use of extra hard special materials on the surface 10a of the roll 10 is feasible and economically advantageous because the roll 10 has a comparatively small diameter and therefore the area coated with a special coating will not be very large. The creping roll 10 is provided with a drive of its own, indicated by the reference numeral 12. As shown schematically in Fig. 2, the creping roll 10 and the transfer suction roll 11 have been suspended from lever arms 50 and 51, which have been attached to the machine frame at the pivot point 52. The arms 50 and 51, or an equivalent unitary frame element, have been provided with force means (not depicted), by means of which an appropriate, comparatively low nip pressure is obtained in the nips N_1 and N_2 .
- 20 The rolls 10 and 11 are preferentially rotatably carried in one unitary frame unit. In that case, however, one has to use in the suspension of rolls 10,11 such spring elements which enable a suitable nip pressure to be obtained in both transfer nips N_1 and N_2 when said frame unit is urged against the cylinder 100 with one single set of force means.

The web W made adherent to the smooth surface 10a of the creping roll 10 is detached with the aid of a creping doctor 17 known in itself in the art. The web, wet-creped in this manner, is indicated by W_c in the figure. There has to be two creping doctors.

As shown in Fig. 2, the Yankee cylinder 100 has no creping doctor at all, merely a cleaning scraper 130 and which at the same time serves as doctor, detaching in the event of running trouble the paper waste from the surface 110 of the Yankee cylinder 100 and transporting it into the waste tray below (not depicted).



As shown in Fig. 2, there follows after the creping means an after-drier substantially consisting of the fabrics 20 and 21.

Immediately below the point of detachment effected by the doctor 17,
5 there is the throat G constituted by the fabrics 20 and 21 - guided
by rolls 22 and 23 - and into which the web proceeds by effect of
dynamic forces and mainly of gravity action. After the convergent
throat G, the fabrics 20 and 21 forming it have a joint run, within
which the web W is interposed between the fabrics 20 and 21. The
10 guide rolls of fabrics 20 and 21 carry the reference numerals 22,23,
24. On the joint run of fabrics 20 and 21, between the rolls 22,23
and 25,26 there has been placed an air drying means, for instance a
blower 30, which is a component known in itself in the art and which
operates with differential pressure effect in likeness of a flow-
15 through drier. This may also be an AIRFOIL system, e.g. in
accordance with the same applicant's patent applications No.

. When passing through this drier 30, the web W attains
the desired ultimate moisture content and it goes by effect of the
suction zone 25 of the roll 25 to the reeling means 41. The reel
20 41 is so located that it is in constant contact with the roll 25,
or immediately adjacent thereto. In this way a fully supported
conduction of the web W is achieved after the creping doctoring,
without any open draws.

25 As shown in Fig. 3, there is used instead of the smooth-surfaced
cylinder 100, a flow-through cylinder 100'. This cylinder has been
provided, in a manner known in itself in the art, with a shell 120
having holes 121. The flow of hot gases through the web W' and the
foraminous cylinder shell 120 is accomplished with the aid of
30 differential pressure between the hood (not depicted) enclosing the
cylinder 100' and the interior cylinder space. The passage of
drying gases through the web W' and through the surface 120 has
been illustrated in Fig. 2 by arrows A. The flow-through cylinder
100' is not fitted with any cleaning doctor; instead an air blowing
35 device (pipe) 140 has been mounted in a proper position, and this
device detaches the waste from the surface 120 of the cylinder 100'
and directs it into the waste tray (not depicted). The air blow tube



140 may also serve as a member by the aid of which one makes sure when the leading strip of the web 100' is being threaded, that the end of the web W' follows along with the surface of the transfer suction roll 11. The design shown in Fig. 3 may be carried out in substantially equal manner as has been done in Fig. 2, but a modification is likewise possible in which no belt, fabric or mat lapping the suction transfer roll 11 is used.

As has been mentioned before, it is of decisive significance in view of the producing a tissue web how uniform is the attachment of the web to the smooth surface of the creping cylinder. The degree of attachment must be appropriate as well - it must not be too firm nor too loose either. In order to promote and optimize this attachment, special steps may be undertaken when the present invention is being applied, if necessary. To this purpose there is, as schematically shown in Fig. 1, in connection with the surface of the creping cylinder 10 an applicator roll 60, which takes up adhesive material from a tank 61 and transfers it onto the smooth surface 10a of the creping roll 10. With equivalent purpose, as shown in Fig. 3, the creping roll 10 has been provided with a press roll 70 placed after the nip N₂. The purpose of the press nip N₃ thereby defined is to urge the web W' against the smooth surface 10a of the roll 10 so that an appropriate, and uniform, contact and adhesion - with a view to the creping event - is achieved between the surface 10a and the web W'.

The adhesion between the web W and the smooth surface 10a of the creping cylinder 10 may also be improved by using special chemicals known in themselves in the art, which are brought into contiguity with the web at a suitable stage and in suitable form, most usually in the form of liquid sprays. Such chemicals may be added to the pulp stock suspension already on the wire section 100'. In such case the "curing time" characteristic of such chemicals is utilized, which makes that the web will not adhere to the surface of cylinders 100, 100', but the chemicals begin to act in controlled manner only at the time when the web arrives on the surface 10a of the creping cylinder 10.



Instead of the transfer suction roll 11 with internal suction zone 11 α , one may equally use other kinds of suction rolls, for instance those provided with a perforated and/or grooved shell and having an external suction box, which will be placed over the sector opposite
5 to the suction sector 11 α .

The Yankee cylinder 100 and the flow-through cylinder 100' naturally require hoods, and the flow-through cylinder 100' also requires sealing means by which the surface of the cylinder external with
10 reference to the hood is closed off. These hoods and equivalent members known in themselves in the art have not been depicted in figures.



Claims

1. Procedure for manufacturing a tissue web (W), wherein the web (W) is formed in the forming section of a tissue paper machine and the web (W) is dewatered in a press section (80), whereafter the web (W) is conducted to a drying section (94;100;100'), where the web (W) is dewatered by evaporation, characterized in that the web (W) is conveyed in closed conduction from the surface of the last drying cylinder (94;100;100') in the drying section onto the suction zone (11 α) of a transfer suction roll (11), supported by which the web (W) is further transported in closed conduction to a smooth-surfaced creping roll (10) or creping cylinder, and that the web (W) is detached from the smooth surface (10a) of said creping roll (10) or creping cylinder by means of a creping doctor (17a,17b), whereupon the web (W) is transferred to the subsequent treatment steps.
2. A tissue paper machine applying to the procedure of claim 1, comprising a drying cylinder such as a Yankee cylinder or a flow-through cylinder and a reeling means (41), characterized in that the means comprises in combination:-
- (a) a transfer suction roll (11) with suction zone (11 α), which defines a transfer nip (N₁) together with the drying cylinder (100;100') and by the aid of which the web (W;W') is without creping doctor detached from the surface of the drying cylinder (100;100');
- (b) a smooth-surfaced creping roll (10) or creping cylinder, defining a transfer nip (N₂) together with said transfer suction roll (11); and
- (c) a creping doctor (17), by means of which the tissue web (W) is detached from the surface of said creping roll (10) or creping cylinder.
3. Tissue paper machine according to claim 2, characterized in that said creping roll (10) or creping cylinder has been provided with a



drive (12) of its own.

4. Tissue paper machine according to claim 2 or 3, characterized in that the smooth-surfaced coating (10a) of said creping roll (10) or creping cylinder has been made of a hard material, for instance of chrome steel.

5. Tissue paper machine according to claims 2-4, characterized in that below said creping roll (10) or creping cylinder in register with the creping doctor (17') has been provided a transfer throat (G) constituted by two fabrics (20,21) and their guide rolls (22,23) and into which the web (W) detached from the surface of the creping roll (10) or creping cylinder, and creped, by the creping doctor (17) is substantially immediately transferred.

6. Tissue paper machine according to claims 2-5, characterized in that the creped tissue web (W) is transported in closed conduction between said fabrics (20,21) up to the reeling means (41) of the tissue paper machine.

7. Tissue paper machine according to claim 5 or 6, characterized in that on the joint run of said fabrics (20,21) has been disposed to serve as after-drier for the web, an air drier or another equivalent after-drier.

8. Tissue paper machine according to claims 2-7, characterized in that a particular fabric (13) has been disposed to lap the transfer suction roll (11).

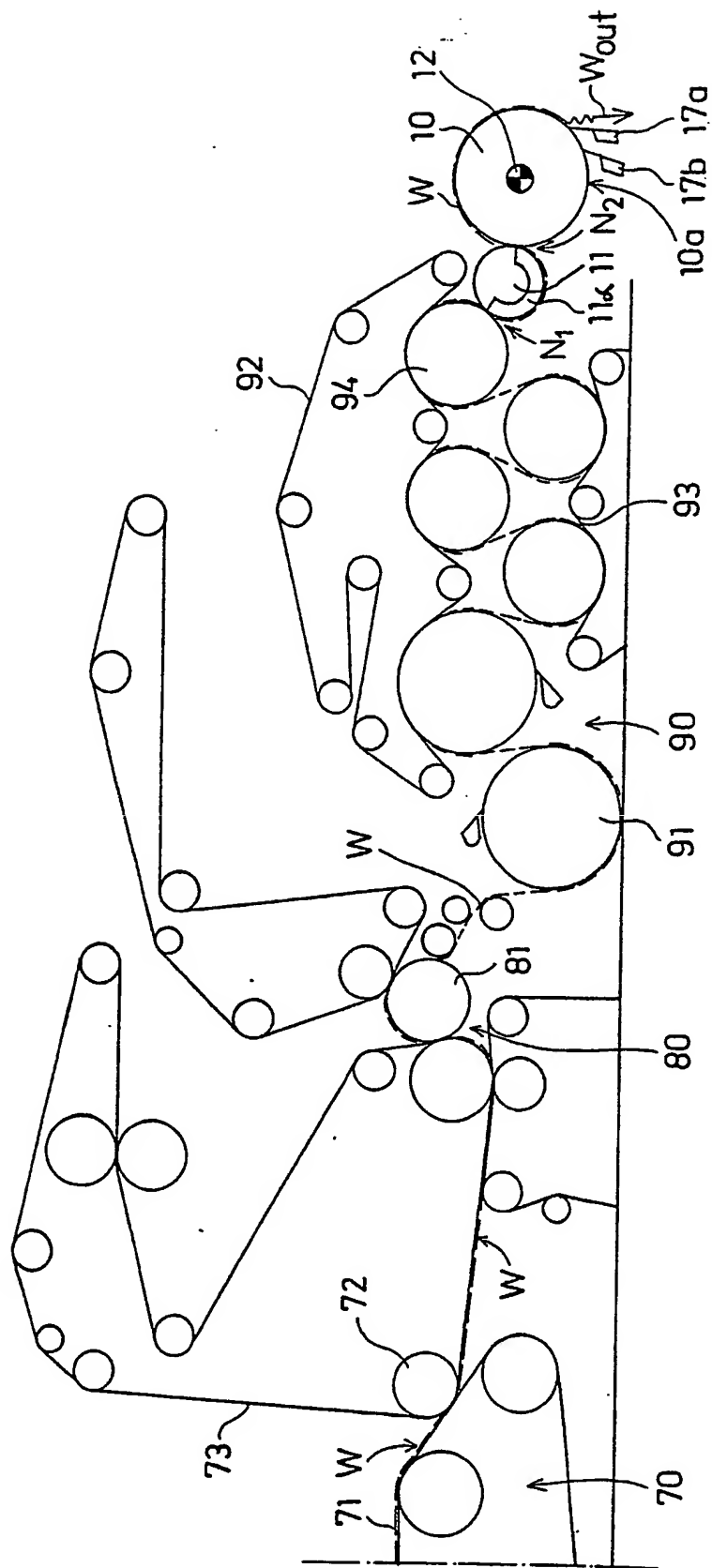
9. Tissue paper machine according to claims 2-8, characterized in that the transfer suction roll (11) and the creping roll (10) or creping cylinder have been rotatably carried in a frame structure (50,51), which has been held turnable about a pivotal axis (52) and so that it is urgable by the aid of force means against the drying cylinder (100;100').

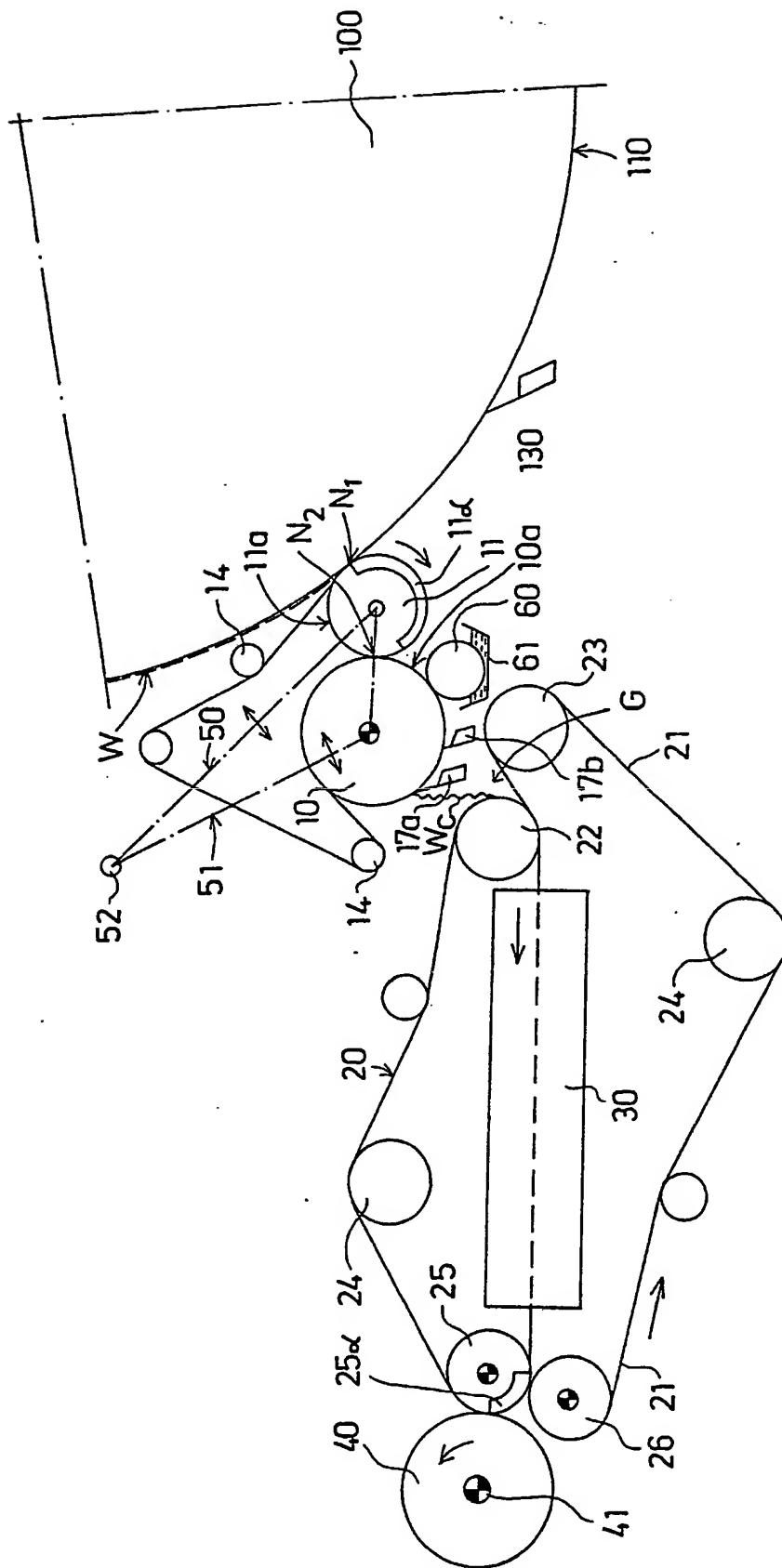


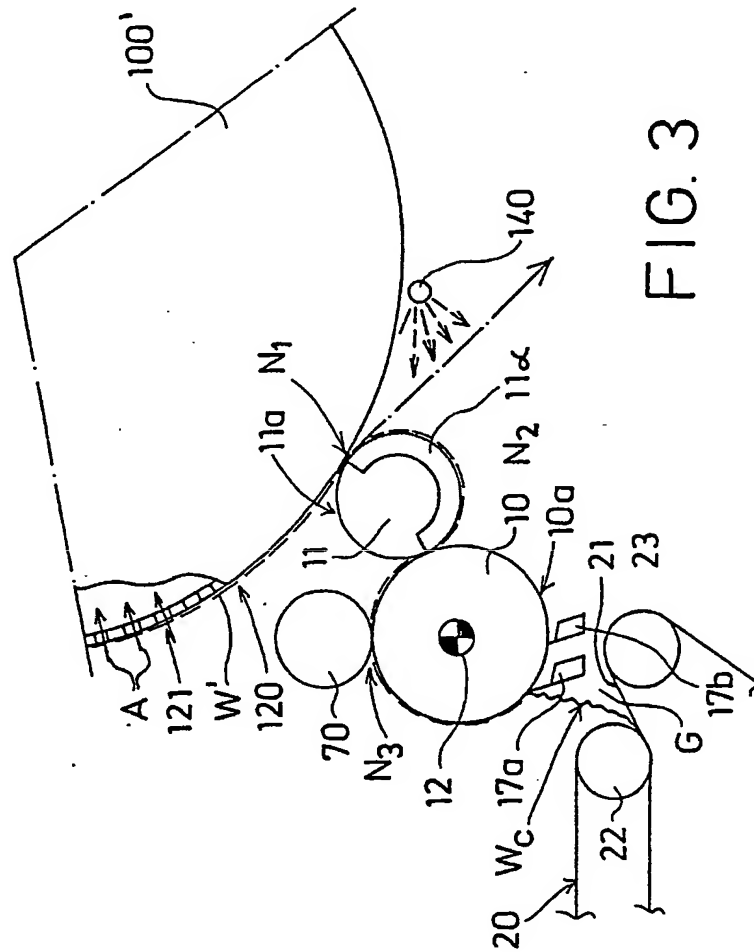
10. Tissue paper machine according to claims 2-9, characterized in that on the sector of the creping roll (10) or creping cylinder left free by the web (W;W') has been placed an applicator roll (60), which applies on the surface (10a) of the creping roll (10) or creping
5 cylinder a substance which promotes the adhesion of the web (W;W') to the surface (10a) of the creping roll (10).

11. Tissue paper machine according to claims 2-10, characterized in that on that sector on which the web (W;W') covers the creping roll
10 (10) or creping cylinder has been disposed a press roll (70) defining a press nip (N₃) together with the creping roll (10) or creping cylinder, this press nip (N₃) having as its purpose to promote the adhesion of the web (W;W') to the surface (10a) of the creping roll (10) or creping cylinder.



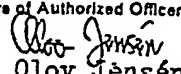






INTERNATIONAL SEARCH REPORT

International Application No PCT/FI81/00019

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC 3		
B 31 F 1/14, D 21 H 5/24		
II. FIELDS SEARCHED		
Minimum Documentation Searched *		
Classification System	Classification Symbols	
IPC 3	B 31 F 1/12, 1/14, D 21 F 11/12, D 21 H 5/24	
US C1	162:111	
National C1	54d:4/02	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched *		
SE, NO, DK, FI classes as above		
III. DOCUMENTS CONSIDERED TO BE RELEVANT 14		
Category *	Citation of Document, 16 with indication, where appropriate, of the relevant passages 17	Relevant to Claim No. 18
X	US, A, 3 812 000 published 1974, May 21, Scott Paper Company	1,2,10
X	US, A, 3 821 068 published 1974, June 28, Scott Paper Company	1,2
<p>* Special categories of cited documents: 15</p> <p>"A" document defining the general state of the art</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document cited for special reason other than those referred to in the other categories</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but on or after the priority date claimed</p> <p>"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search 1	Date of Mailing of this International Search Report 2	
1981-06-25	1981-07-03	
International Searching Authority 3	Signature of Authorized Officer 10	
Swedish Patent Office	 Olov Jansen	